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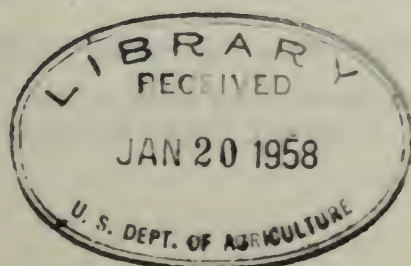
Commercial rice production in California began in 1912, when 1400 acres were sown. In 1954, the area under production was approximately 460,000 acres. The crop is grown largely on the heavy clay and clay-adobe soils in the Sacramento and San Joaquin valleys.

The climate of the interior valleys is hot and dry in the summer, with rain in the fall, winter and spring. During the late summer when rice is flowering, the day temperatures are high but the nights are cool. Pollen tube growth is inhibited when the temperature is below 50° F., and excessive sterility may then occur. Delayed maturity caused by late seeding, excess fertilizer or late-maturing varieties increases the hazards of loss from sterility caused by low temperatures. Late rains in the spring often delay preparation of the seedbed and in certain years early rains in the fall greatly hamper harvest operations. A variety, to be adapted under these climatic conditions, must mature in 155 days or less after sowing. This means that about 170 days is available between the beginning of seedbed preparation and rice harvest. Most of the rice-growing areas of the World have a longer season.

1/ Contribution of the Field Crops Research Branch, Agricultural Research Service, United States Department of Agriculture, and the California Agricultural Experiment Station.

2/ Agent (Agronomist), FCRB, ARS, USDA.

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Breeding experiments are needed to develop varieties that are adapted, that do not lodge, have the desired milling and cooking quality, and produce high yields. Such varieties help to insure an equitable return on the large investment in land and equipment necessary to produce rice. The Caloro, Calrose, and Colusa varieties, released by the Rice Experiment Station, Biggs, California, are grown on most of the rice acreage in California. These varieties meet some but not all of the objectives of the breeding program.

Wataribune (C.I. 1561) ^{3/} was the leading variety for the first few years rice was grown in California. It was a long-season, high-yielding, short-grain variety of the Japanese type. It had good milling quality, but matured too late under California conditions.

Caloro was selected at Biggs in 1913 from an introduction received from Japan. This introduction was similar to Wataribune except that it matured about a week to 10 days earlier. Several selections made from this introduction were tested at the Biggs Rice Field Station. One of these selections was increased and released to growers under the name Caloro in 1919. Caloro is a Japanese type, short-grain, partly awned variety that matures in about 155 days. It is adapted to a wide variety of growing conditions and produces high yields of fair-quality rice. Caloro was grown on about 85 percent of the California acreage in 1955.

^{3/} Refers to the Cereal Accession Number, United States Department of Agriculture - Cereal Crops Section.

Colusa (or C.I. 1600) is an early-maturing, short-grain, awnless variety, selected out of the Italian variety, Chinese Originario, at the Rice Experiment Station, Crowley, Louisiana and released in 1917. It is not well adapted in the South, but it is the leading early-maturing variety in California. It has weak straw and often lodges when the growth is rank and it tillers poorly on previously cropped land. In most years it is lower in yield than Caloro although the milling quality is fairly good. Colusa was grown on about 10 percent of the California rice acreage in 1955.

Calrose was selected out of the Caloro-Calady x Caloro backcross and it was released from the Biggs Station in 1948. It is a medium grain, partly-awned variety, similar to Caloro in growth habit, maturity and yield, but superior to Caloro in quality. Calrose seedlings have difficulty in coming through the water, being inferior to Caloro in this respect. Calrose is grown on about 5 percent of the California rice acreage. It commands a premium in price over the short-grain (Pearl) varieties in markets where a medium-grain rice is preferred.

Although the rice varieties now available for growing in California are much better adapted than the varieties grown 40 years ago, they lack many of the characteristics needed. The objectives of the breeding investigations are to develop early and midseason, short- and medium-grain varieties that are tolerant to cold water and to cool weather during flowering and ripening; tiller adequately; do not lodge; respond to fertilizer; and produce high field and mill yields of grain that meet

the demands of the trade. An effort is being made to develop these new improved varieties with smooth hulls as this latter characteristic improves the ease and economy of handling and storing. Additional objectives are to develop long-grain and glutinous varieties that have the other characteristics enumerated above.

The methods being used and the results of some of the experiments to meet these objectives are reported here.

Cold Water Tolerance

The detrimental effect of cold water on stands and yield in rice is well known. In recent years, this problem has become acute in the western portion of the Sacramento Valley, where the major source of irrigation water for rice is the Sacramento River, whose headwaters are now impounded in the Shasta reservoir. Water temperatures now average about 10° F. cooler than before the Shasta dam was built.

Ninety-seven varieties were tested for cold-water tolerance in 1955 in plots adjoining the Glenn-Colusa canal. Average minimum water temperatures did not vary much throughout the nursery, while average maximum temperatures ranged from 65° F. at the intake box to about 85° at the outlet box. Most of the entries were not headed by September 15 and the varieties that headed were delayed about 1 week on an average.

At present none of the rice varieties grown in the United States have complete tolerance to cold water but certain varieties tested have the ability to come through the water with average minimum temperatures of 65° to 70° F. Few of the varieties emerge when the temperature of the water is below 65° F.

Over 200 varieties received from Hokkaido, Japan, are now being grown in the breeding nursery for observation and increase. These lines will be tested for cold-water tolerance and the better lines will be crossed onto our commercial varieties. This problem is of major importance.

Quality Studies

F₂ plants from backcross made in 1953, involving Caloro and Calrose, were selected for desirable agronomic and grain characteristics. Thirty-five F₃ lines from the above F₂ plants are now being grown and will be tested for milling quality. Samples from some of the F₂ plants of these lines were examined by X-ray to determine whether the presence of fractures in the kernel might be correlated with milling quality.

The varieties in the 1955 yield trials were tested at the U.S.D.A. Rice Quality Laboratory at the Rice-Pasture Experiment Station at Beaumont, Texas, for milling quality and chemical characteristics. Several short- and medium-grain lines gave high mill yields and low readings in the starch-iodine-blue tests.

About 100 F₅, F₆, and F₇ lines from earlier crosses that appeared uniform and vigorous were harvested in the selection nursery in 1955, and these are being tested for yield, milling quality and other characters in 1956.

Straw Strength

In 1954, four lines from Maratelli (C.I. 8910), a rice variety from Italy, were crossed with Colusa. Maratelli is about 3 weeks earlier and has stiffer straw, less total leaf area, more productive tillers and larger panicles than Colusa. However, Maratelli has a large, coarse kernel

that is undesirable from a milling standpoint. About 600 F_3 lines from these crosses are being grown for observation. Plants that have the plant type of C. I. 8910 and the grain type and quality of Colusa will be saved for further experiments.

Smooth Hull Varieties

In 1946 and 1948, selected smooth-hull cultures were crossed with the three commercial California varieties, and some of the best breeding lines. These hybrid progenies have since been carried on both in bulk and pedigree cultures. The most promising lines having smooth hulls are: 4620A and 4819A (smooth Colusa types); 4617A, 4625A, 484A, and 487A (smooth Caloro types); and 463A (Smooth Calrose types).

In 1953, selections from 4819A9 and 4819A10 were backcrossed to Colusa and certain smooth-hull progeny backcrossed to Colusa in 1955. Selected smooth-hull plants from the hybrid family, 4620A, were backcrossed to Colusa in 1955. The best progeny of these backcrosses will be crossed to C. I. 8910 for straw strength in 1957.

Selected plants of hybrid families 484A and 487A were backcrossed to Caloro. The progeny of this backcross will be examined critically this year and the better plants will be grown in pedigree rows in 1957.

The better smooth-hull plants of the Calrose type were backcrossed to Calrose in 1956. A number of the smooth Calrose sorts were in the preliminary yield trials in 1956. Further studies on milling quality and emergence in cold water of the better of these smooth-Calrose lines will be carried out in 1957.

Comparative yields of the best smooth-hull lines and the commercial varieties in 1954 and 1955 are as follows:

	<u>1954*</u>	<u>1955</u>
Caloro	1374	3039**
487A1-12 (Smooth Hull)	1100	3763
Colusa	1813	2819**
4819A1-12 (Smooth Hull)	1830	3351
Calrose	2041	3285**
4631A1-5 (Smooth Hull)	1502	3337

* The yields of all entries in the yield trials were generally very low due to adverse weather conditions.

** The yields of the commercial checks are an average of several plots.

These preliminary results indicate that the smooth hull lines may yield as well as the rough-hull varieties.

A long-grain rice for California

One of the breeding goals is the development of a long-grain rice adapted to California conditions. The Indica-type varieties from the tropics are not hardy enough to withstand the extreme fluctuations in temperature that occur in California. The better long-grain varieties from the Southern States have been crossed with the hardy varieties grown in California. These crosses were made in 1950, 1951, and 1952, and the progeny were studied in 1954 and 1955. Many of the long-grain lines failed to mature in 1954 because of the adverse season. The lines that had the best grain type and the least sterility were saved for testing in 1955. Most of the material was eliminated in 1955 because of late maturity, poor plant type, or poor grain type, although a few long-grain plants were selected from F₃ and F₄ lines for testing in 1956.

Several early lines selected from the cross Rexoro x Red Rice have a desirable plant and grain type. Some of the better lines will be crossed with Caloro. The long-grain varieties are variable in behavior and they yield considerably less than short-grain varieties in California.

Glutinous Varieties

There is not a large demand for glutinous rice in the United States, so only limited work is being done to develop better varieties of this type. However, a number of crosses have been made between glutinous and common varieties. The progeny from these hybrids are being tested. Some of these selections appear to be better than the glutinous varieties now grown in California.



